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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2022/2023 (TERM ID 2210)

HCB1011 – CELL BIOLOGY

(All sections / Groups)

13 FEBRUARY 2023

9.00 a.m. – 11.00 a.m.

(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of **5** pages with **4** Questions only.
2. Answer **ALL THE QUESTIONS**. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please print all your answers **clearly** and **neatly** in the Answer Booklet provided.

QUESTION 1

- (a) Which element of the cell theory has practical applications in health care because it promotes the use of sterilization and disinfection? [1 mark]
- (b) Name the processes below:
- i. The process by which a cell engulfs a foreign particle. [0.5 mark]
 - ii. Passive movement of solutes through transport proteins in the plasma membrane. [0.5 mark]
 - iii. The process by which ATP synthesis is coupled to the movement of electrons through the mitochondrial electron transport chain and the associated consumption of oxygen. [0.5 mark]
 - iv. The laboratory process of pairing and ordering all the chromosomes of an organism, thus providing a genome-wide snapshot of an individual's chromosome. [0.5 mark]
- (c) When Baby John was born, doctor found that his body is unable to bind additional sugar building blocks (glycans) to proteins in cells. Which organelle would be most commonly involved in these disorders? [0.5 mark]
- (d) Mucopolysaccharide Storage Diseases are caused by disturbances in the normal breakdown of complex carbohydrates known as mucopolysaccharides. Which organelle would be most commonly involved in these disorders? [0.5 mark]
- (e) Name FOUR components of the endomembrane system. [2 marks]
- (f) What are plasmids and their importance in bacteria? [2 marks]
- (g) The term junk DNA refers to regions of DNA that are noncoding. Scientists once thought noncoding DNA was "junk," with no known purpose. However, it is becoming clear that at least some of it is integral to the function of cells. Name at least TWO functions of non-coding DNA that have been discovered. [2 marks]

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QUESTION 2

- (a) What is the purpose of DNA replication? Why is it important? [2 marks]
- (b) What are Okazaki fragments and how they are formed? [1 mark]
- (c) Describe the roles of DNA polymerase I and DNA ligase in DNA replication. [2 marks]
- (d) A missense mutation has occurred in the DNA and in the mRNA for a gene. Which mutation would have a more significant effect? Why? [2 marks]
- (e) If mRNA is complementary to the DNA template strand and the DNA template strand is complementary to the DNA non-template strand, why are base sequences of mRNA and the DNA non-template strand not identical? Could they ever be? [1 mark]
- (f) Eukaryotic mRNAs must undergo several processing steps before they can be transferred from the nucleus to the cytoplasm and translated into a protein. What is the purpose of RNA processing? What are the THREE major eukaryotic RNA processing events? [2 marks]

QUESTION 3

- (a) What are the THREE major components involved in protein translation? [1 mark]
- (b) The genetic code is described as degenerate. What does it mean? [1 mark]
- (c) A scientist is investigating a newly discovered polypeptide that is 465 amino acids long. What is the minimum number of bases in the gene coding for this polypeptide? [1 mark]
- (d) A tRNA is chemically modified so that the amino acid bound is different than the one specified by its anticodon. Which codon in the mRNA would the tRNA recognize: the one specified by its anticodon or the one that matches the modified amino acid it carries? [1 mark]

Continued...

- (e) Suppose a gene has the sequence ATGCGTTATCGGGAGTAG. A point mutation changes the gene to read ATGCGTTATGGGGAGTAG. How would the polypeptide product of this gene change? Show the amino acid sequences of the polypeptide products (original and mutant). You may refer to the codon chart below. [2 marks]

		Second Letter										
		U		C		A		G				
1st letter	U	UUU	Phe Leu	UCU	Ser	UAU	Tyr Stop Stop	UGU	Cys Stop Trp	U	3rd letter	
		UUC		UCC		UAC		UGC		C		
		UUA		UCA		UAA		UGA		A		
		UUG		UCG		UAG		UGG		G		
	C	CUU	Leu	CCU	Pro	CAU	His Gln	CGU	Arg	U		
		CUC		CCC		CAC		CGC		C		
		CUA		CCA		CAA		CGA		A		
		CUG		CCG		CAG		CGG		G		
	A	AUU	Ile Met	ACU	Thr	AAU	Asn Lys	AGU	Ser Arg	U		
		AUC		ACC		AAC		AGC		C		
		AUA		ACA		AAA		AGA		A		
		AUG		ACG		AAG		AGG		G		
	G	GUU	Val	GCU	Ala	GAU	Asp Glu	GGU	Gly	U		
		GUC		GCC		GAC		GGC		C		
		GUA		GCA		GAA		GGA		A		
		GUG		GCG		GAG		GGG		G		

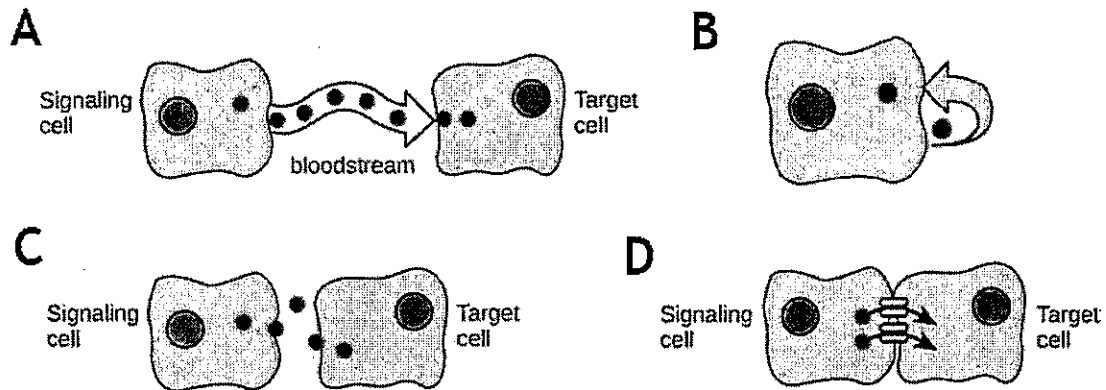
- (f) What happens to the proteins that are synthesized on free ribosomes in the cytoplasm? Do they go through the Golgi apparatus? [1 mark]
- (g) Pathogenic *E. coli* have recently been shown to degrade tight junction proteins during infection. How would this provide an advantage to the bacteria? [1 mark]
- (h) The extracellular matrix (ECM) serves diverse functions and is a major component of the cellular microenvironment. What happens if the ECM is defective? Name TWO possible outcomes. [2 marks]

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QUESTION 4

(a) Name the modes of cell signaling below:

[2 marks]



(b) Explain the difference between a proto-oncogene and a tumor suppressor gene. [1 mark]

(c) Name SIX characteristics of cancer cells.

[3 marks]

(d) Chemotherapy drugs such as vincristine and colchicine disrupt mitosis by binding to tubulin (the subunit of microtubules) and interfering with microtubule assembly and disassembly. Exactly what mitotic structure is targeted by these drugs and what effect would that have on cell division? [1 mark]

(e) In recent years, stem cell therapy has become a very promising and advanced scientific research topic.

i. What are the unique features (name TWO) about stem cells that make them different from other mature cell types? [1 mark]

ii. Where do scientists get stem cells from? Name at least TWO sources. [1 mark]

iii. What are the ethical issues with stem cell research? [1 mark]

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